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Original Article

Determination of Bio-chemical Properties of Plants In Polluted Areas

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ABSTRACT

The current study was done to examine the impact of industrial air pollution on biochemical properties ofProsopis juliflora and Abuliton indicum plants using two sites; polluted area (Korangi industrial area) and non-polluted area (University of Karachi Campus). Biochemical characteristics of the plants were studied in both the sites and compared with each other. It was found that plants exposed to industrial pollution showed lower amounts of chlorophylls, carotenoids and relative water contents as compared to plants growing in non-polluted site.

Introduction

In recent past, air pollutants, responsible for vegetation injury and crop yield losses, are causing increased concern (Joshi and Swami, 2007). Urban air pollution is a serious problem in both developing and developed countries (Li, 2003). The increasing number of industries and automobile vehicles are continuously adding toxic gases and other substances to the environment (Jahan and Iqbal, 1992). All combustion release gases and particles into the air. These can include sulphur and nitrogen oxides, carbon monoxide and soot particles, as well as smaller quantities or toxic metals, organic molecules and radioactive isotope (Agbaire and Esiefarienrhe, 2009). Environmental stress, such as air pollution, is among the factors most limiting plan productivity and survivorship (Woo et al., 2007). Pollutants could be classified as either primary or secondary. Pollutants that are pumped into the atmosphere and directly pollute the air are called primary pollutants while those that are formed in the air when primary pollutants react or interact are known as secondary pollutants (Agbaire, 2009).

It has been observed that plants particularly growing in the urban areas affected greatly due to varieties of pollutants [oxides of nitrogen and sulphur, hydrocarbon, ozone, particulate matters, hydrogen fluoride, peroxyacyl nitrates (PAN) etc. (Jahan and Iqbal, 1992). Sulphur dioxide (SO2), nitrogen oxides (NO2) and CO2 as well as suspended particulate matter, when absorbed by the leaves may cause a reduction in the concentration of photosynthetic pigments viz., chlorophyll and carotenoids, which directly affected to the plant productivity (Joshi and Swami, 2009).). Adverse effects of air pollution on biota and ecosystems have been demonstrated worldwide. Much experimental work has been conducted on the analysis of air pollutant effects on crops and vegetation at various levels ranging from biochemical to ecosystem levels (Tiwari et al., 2006). Industrialization and the automobiles are responsible for maximum amount of air pollutants and the crop plants are very sensitive to gaseous and particulate pollutions and these can be used as indicators of air pollution (Joshi et al., 2009). In urban environments, trees play an important role in improving air quality by taking up gases and particles (Woo and Je, 2006). Plants provide an enormous leaf area for impingement, absorption and accumulation of air pollutants to reduce the pollutant level in the air environment, with various extent for different species (Liu and Ding, 2008). They act as the scavengers for many air borne particulates in the atmosphere (Joshi and Swami, 2009). The genus Prosopis is in the family Leguminosae (Fabaceae), sub-family Mimosoideae. The native range of Prosopis species can be approximately divided into five regions, simply defined as Asia, Africa, North America, Central America and South America. The genera Prosopis contain some of the most widespread and important tree species in the arid and semiarid zones of the tropical and sub-tropical world. The genus Prosopis contains 44 species and a large number of varieties. The genetic variation of P. juliflora is high for all characters tested in the species (Kumar et al., 1998). Prosopis is able to improve the soil in which it is growing by means of biological nitrogen fixation, leaf litter accumulation, nutrient pumping from deeper soil layers, loosening of a hard soil structure, stabilizing of loose sands, and an increase of the fauna above and below the ground (Kaushik and Kumar, 2003

Similarly, the Abutilon genus of the Malvaceae family comprises about 150 annual or perennial herbs, shrubs or even small trees widely distributed in the tropical and subtropical countries of America, Africa, Asia and Australia (Sikorska and Matlawska, 2008). Various plants of Abutilon species are traditionally claimed for their varied pharmacological and medicinal activities. Furthermore, different plant parts contain specific phytoconstituent responsible for their biological activity (Matlwaska 2002). The plant Abutilon indicum of this genus is a small shrub, native to tropic and subtropical regions and sometimes cultivated as an ornamental plant. This plant is often used as a medicinal plant and is considered invasive on certain tropical islands. In traditional medicine, leaves of A. indicum is used as a demulcent, aphrodisiac, laxative, diuretic, pulmonary and sedative (Rajakaruna et al., 2002). The bark is astringent and diuretic; laxative, expectorant and demulcent. The plant tends to have a weedy character, often found growing in disturbed sites

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(Gamble, 2008). In order to understand the effects and alterations due to industrial pollutants in plants, present study conducted to examine the effects of industrial pollution on biochemical properties of *P. juliflora* and *A. indicum* plants.

Materials and Methods

Collection of plants

Leaves samples of Abuliton indicum and Prosopis juliflora plants were collected from two different sites such aspolluted area (Korangi industrial area) and non-polluted area (University of Karachi Campus)for biochemical testing in order to determine theeffects of industrial pollution.

- **Relative water content**

Four leaf discs of *A. indicum*(1.2 cm2) and 4 leaf discs of *P. juliflora*(1.2 cm2) were excised and fresh weights (FW) were determined. For the measurement of turgid weight, leaves were left in distilled water for 24 hours under low irradiance condition. Samples were then dried at 80°C for 48hours in oven and dry weight (DW) was determined. Relative water content (RWC) was calculated by the fresh leaves samples method described by Barrs and Weatherley (1962) as RWC = (FW – DW / TW – DW) × 100

- **Estimation of Chlorophyll and carotenoid contents**

0.5g weighed leaf samples were ground in 10ml of 96% methanol and then centrifuge at 4000rpm for 10minutes. Total chlorophyll [Chl (a+b)], chlorophyll "a" (Ca), and chlorophyll "b" (C_b) contents were determined according to Lichtenthaler (1987). The supernatant was separated and the absorbances were read at 666, 653 and 470nm on spectrophotometer. The amount of these pigments was calculated according to the following formulas;

Chl "a" =15.65 A_{666} - 7.340 A_{653}

Chl "b" =27.05 A_{653} - 11.21 A666

Carotenoids = 1000 A_{470} - 2.860 C_a - 129.2 C_b/245

Where,

C_a = Chlorophyll a, C_b = Chlorophyll b,

C_a+ Cb = Total chlorophyll

Chlorophyll contents of leaf tissues were expressed on a leaf area basis (mol m^{-2}).

- **Statistical analysis**

Statistical analysis was carried out using the personal computer software packages SPSS version 18.0. The data collected for various parameters subjected to statistical analysis that is calculated by paired "t"test between two localities of plant samples.

Table. 1. Relative water contents (%)

Plants	Sampling Location	R.W.C % (gm)
A .indicum	University of Karachi Campus	75.33b±1.20
	korangi	55.48a±6.00
P. juliflora	University of Karachi Campus	69.16c±4.28
	korangi	54.23a±6.30

Table. 2. Total chlorophyll contents

Plants	Sampling Location	Total Chl. (ug mg $^{-1}$ Fw)
A .indicum	University of Karachi Campus	14.62b±0.16
	korangi	5.52a±0.13
P. juliflora	University of Karachi Campus	12.05b±0.08
	korangi	4.70a±0.13

Table. 3.Estimation of Carotenoids

Plants	Sampling Location	Carotenoids (ug mg $^{-1}$ Fw)
A .*indicum*	University of Karachi Campus	9.236b ± 0.21
	korangi	6.56a ± 0.23
P. *juliflora*	University of Karachi Campus	11.2c ± 0.30
	korangi	5.54a ±0.11

Results

- **Relative water contents**

Plant P. juliflora of University of Karachi Campus showed high relative water contents as compared to the plant P. julifloraof korangi industrial area which showed lower amounts of relative water contents (Table. 1). Similarly, plant A. indicum of non-polluted areafound to have significant amounts of relative water contents as compared to the plants of polluted area having less relative water contents. So there is a significant differences found in the relative water contents in between the plants of both of the localities (polluted and non-polluted areas)

- **Total chlorophyll contents**

Data presented in (Table. 2) showed that A.indicumof University Campus have significantly increased chlorophyll contents as compared to theA. indicum of korangi industrial area. Whereas,P. juliflora of non-polluted University campus showed higher amount of chlorophyll contents as compared to the P. juliflora of polluted area of korangi which showed lower value of total chlorophyll contents so, significant differences have also been found in the chlorophyll contents of the plants of both the areas.

Carotenoids

According to Table. 3, A .indicumof University of Karachi campus found to have more significant amounts of carotenoids when compared with the A. indicum of korangi industrially polluted area which contains less amounts of carotenoids. Similarly, P. julifloraof non-polluted area contain greater carotenoids amounts as compared with the P. juliflora of korangi industrial area which contains higher value of carotenoids so, significant differences occur in between the carotenoids amounts of both the plants in polluted and non-polluted areas..

Discussion

In the present study, examination of biochemical properties of plants of industrially polluted site and non-polluted site showed that industrial pollution have adverse effects on the biochemical properties of plants. Industrial pollution is one of the severe problems facing the world today. It deteriorates ecological condition and can be defined as the fluctuation in any atmospheric constituent from the value that would have existed without human activity (Tripathi and Gautam, 2007). Pollutants can cause leaf injury, stomatal damage, premature senescence, decrease photosynthetic activity, disturb membrane permeability and reduce growth and yield in sensitive plant species (Tiwari et al., 2006).It is reported that depending on their sensitivity level, plants show visible changes which would include alteration in the biochemical processes or accumulation of certain metabolites (Agbaire and Esiefarienrhe, 2009).According to our results, P. juliflora and A. indicumplants of University of Karachi Campus (non-polluted area) showed high amounts relative water contents, chlorophylls and carotenoids as compared to the P. julifloraA. indicum of korangi industrial area (polluted area) which showed lower amounts of relative water contents. Our results agree with Mansoor and Haniyeh, 2011 who also found that when plants exposed to industrial pollution, their bio-chemical properties have been reduced considerably. Tiwari et al., 2006 stated that pollutants can cause leaf injury, stomatal damage, premature senescence, decrease photosynthetic activity, disturb membrane permeability and reduce growth and yield in sensitive plant species.One of the most common impacts of air pollution is the gradual disappearance of chlorophyll and concomitant yellowing of leaves, which may be associated with a consequent decrease in the capacity for photosynthesis (Joshi and Swami, 2007).

Conclusion

Based on the results of this study, it can be concluded that industrial pollution causes adverse effects on the biochemical properties of plants like relative water contents, chlorophylls and carotenoids reduced considerably. These biochemical parameters are important in the study of plant-environment interactions as they can serve as bioindicators of air pollution. So, industrial pollution must be removed from the environment in order to have healthy plants containing higher amounts of biochemical properties

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